NASA Facts

National Aeronautics and
Space Administration

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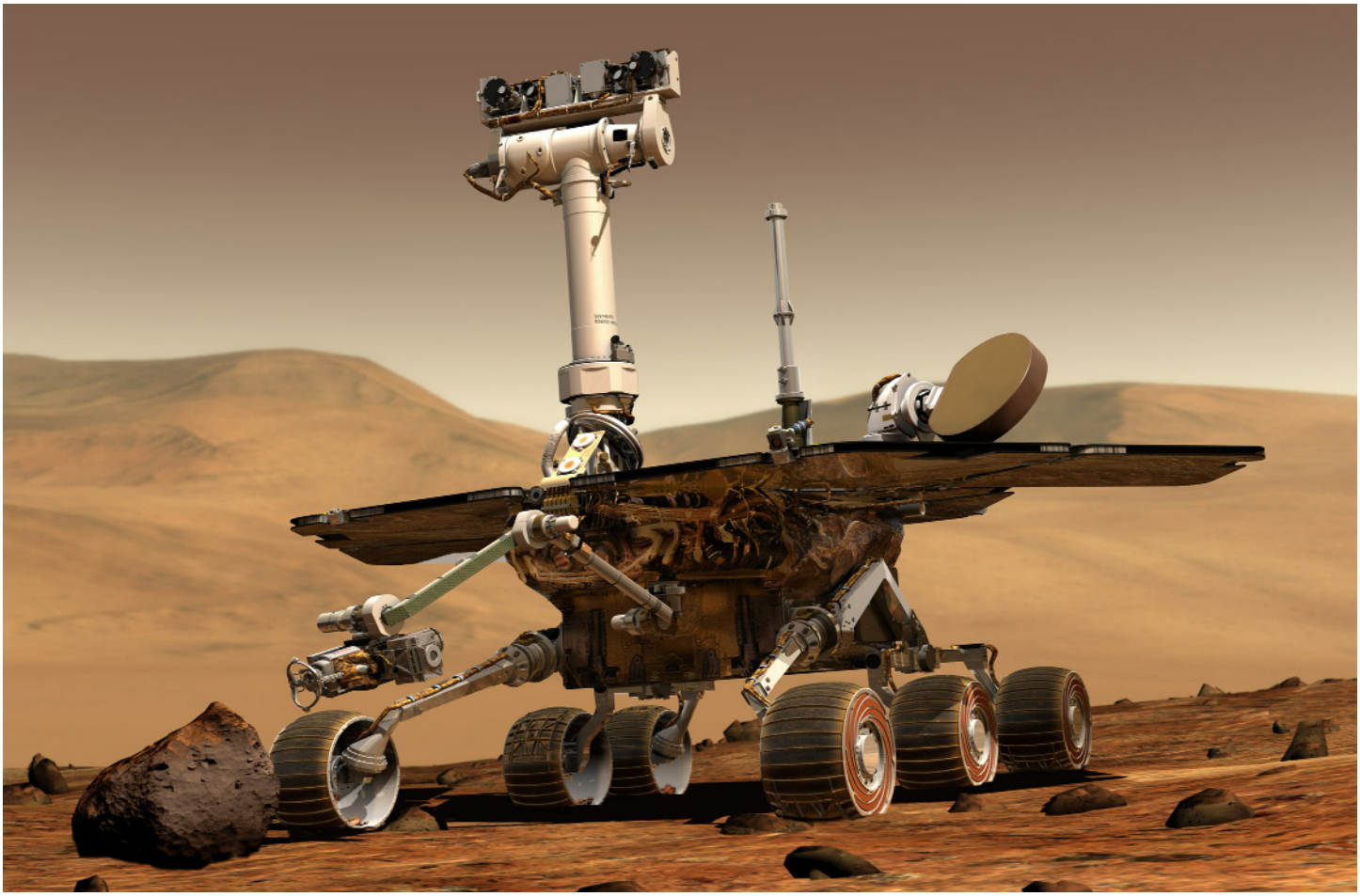
Mars Exploration Rover

NASA has launched two powerful new Mars rovers named Spirit and Opportunity. With far greater mobility than the 1997 Mars Pathfinder rover, these robotic explorers will be able to trek up to about 40 meters (44 yards) across the surface in a martian day. Each Mars Exploration Rover carries a sophisticated set of instruments to search for evidence about whether past environments at selected sites were wet enough to be hospitable to life. The two rovers are identical, but will land at different regions of Mars.

Mission Overview

Both rovers were launched from Cape Canaveral Air Force Station, Florida. Spirit ascended on June 10, 2003, and Opportunity followed on July 7, 2003. Spirit will reach Mars January 4, 2004, Opportunity on January 25, 2004.

The landing for each will resemble that of the Pathfinder spacecraft. A parachute will deploy to slow the spacecraft and airbags will inflate to cushion the



landing. Upon reaching the surface, the spacecraft will bounce at least a dozen times, and could roll a kilometer or more (about one-half mile) before coming to a stop. When it stops, the airbags will deflate, retract and the spacecraft's petals will open up, bringing the lander to an upright position and revealing the rover. The landed portion of the Mars Exploration Rover mission features a design dramatically different from Mars Pathfinder's. Where Pathfinder had scientific instruments on both the lander and the small Sojourner rover, Spirit and Opportunity will carry all their instruments with them. Immediately after landing, the rover will begin reconnaissance of the landing site by taking a 360-degree visible color and infrared image panorama. It will then leave the lander structure behind, driving off to begin its exploration.

Rocks and soils will be analyzed with a set of five geology instruments on each rover, and a special tool called the rock abrasion tool, or "RAT," will be used to expose fresh rock surfaces for study.

Using images and measurements received daily from the rovers, scientists will command the vehicle to go to rock and soil targets of interest and evaluate their composition and their texture at microscopic scales. Initial targets will be near the landing sites, but later targets could be far afield. Sojourner traveled about the length of about one football field during its 12 weeks of activity on Mars. Each Mars Exploration Rover is expected to travel six to 10 times that distance during its three-month prime mission.

Like the Sojourner rover, Spirit and Opportunity will use radioisotope heater units inside the rover electronics box in order to keep the rover battery and electronics warm and operational during the extremely cold martian nighttime. The coldest atmospheric nighttime temperatures the two rovers are expected to experience are minus 105 degrees Celsius (minus 157 degrees Fahrenheit). The electronics inside the rover are qualified for survival and operation down to minus 55 degrees Celsius (minus 67 degrees Fahrenheit). Each rover will have eight radioisotope heater units, each containing approximately 2.7 grams (about 0.1 ounce) of plutonium dioxide.

Each rover has a mass of nearly 180 kilograms (about 400 pounds) and is expected to travel up to about 40 meters (44 yards) per sol, or martian day. Surface operations will last for at least 90 sols (92 Earth days) for each rover, extending to late April 2004, but could continue longer depending on the health of the vehicles.

Science Goals

The mission seeks to determine the history of climate and water at two sites on Mars where conditions may once have been favorable to life.

Two landing sites were selected on the basis of intensive study of orbital data collected by the Mars Global Surveyor and Mars Pathfinder missions. Both sites show evidence of ancient water. Spirit will go to Gusev Crater, a wide basin that may once have held a lake. Opportunity's destination is Meridiani Planum, an area about halfway around Mars from Gusev that has a broad outcropping of a mineral -- gray hematite -- that usually forms in the presence of liquid water. The rovers' instruments will study the geologic record at the sites, and evaluate whether those conditions would have been suitable for life.

Science Instruments

Each rover carries five scientific instruments and an abrasion tool: a Panoramic Camera provided by JPL; a Miniature Thermal Emission Spectrometer from Arizona State University, Tempe; a Mössbauer Spectrometer from the Johannes Gutenberg University, Mainz, Germany; an Alpha-Particle X-ray Spectrometer from Max Planck Institute for Chemistry, also in Mainz, Germany; and a Microscopic Imager from JPL. The Rock Abrasion Tool, or "RAT," provided by Honeybee Robotics, New York, N.Y., will grind away the outer surfaces of rocks, which may be dusty and weathered, to expose the rock interiors for examination. The payload also includes magnetic targets provided by Niels Bohr Institute in Copenhagen, Denmark. The spectrometers, microscopic imager and abrasion tool are deployed on a robotic arm.

● ***Panoramic Camera: Providing the Geologic Context***

The terrain around the rover will be revealed by this instrument in a seach for evidence of the action of liquid water. Camera images will be used to help select the most promising rock and soil targets for more intensive study, and to pick new regions for the rover to explore. Its resolution is more than three times better than that of the cameras carried on the Mars Pathfinder lander.

● ***Miniature Thermal Emission Spectrometer: Identifying Minerals at the Site***

This instrument will view the scene around the rover in the infrared, determining types and amounts of many different kinds of minerals. A particular goal is to search for distinctive minerals that are formed by the action of water. The spectrometer will scan to build up a panoramic image. Data from it and from the Panoramic Camera will be used choosing science targets and new areas to explore.

● ***Mössbauer Spectrometer: Identifying Iron-Bearing Minerals***

Mounted on the rover arm, this instrument will be placed against rock and soil targets. It identifies any minerals that contain iron, and will help scientists evaluate what role water played in the formation of these minerals and discern the extent to which rocks have been weathered. The instrument uses two cobalt-57 sources, each about the size of a pencil eraser, in calibrating its measurements. It is a miniaturized version of spectrometers used by geologists to study rocks and soils on Earth.

● ***Alpha Particle X-Ray Spectrometer: Determining the Composition of Rocks***

An improved version of an instrument used by the Sojourner rover, this spectrometer is also similar to instruments used in geology labs on Earth. It uses small amounts of curium-244 in measuring the concentrations of most major elements in rocks and soil and determines how they have been altered over time.

● ***The Microscopic Imager: Looking at Fine-scale Features***

The fine-scale appearance of rocks and soils can provide essential clues to how those rocks and soils were formed. For instance, the size and angularity of grains in water-lain sediments can reveal how they were transported and deposited. This imager will provide the close-up data needed for such studies.

Launch Safety

For four decades, NASA has safely used radioactive materials in a variety of scientific instruments and for spacecraft heating or electrical power when necessary. Even in the event of a launch accident that might have released radioactive materials, no health consequences would have been expected for the public or launch-area employees. Even in the event of a release, the person with the highest exposure would typically receive less than a few tens of millirem. (The average annual dose from naturally occurring sources of radiation in the United States is about 300 millirem per year.) No health consequences would be expected from such a low level of radiation exposure.

Names

The names of the rovers, Spirit and Opportunity, were selected in a student essay contest that drew nearly 10,000 entries.

Project/Program Management

The Mars Exploration Rover program is managed for NASA by JPL, a division of the California Institute of Technology, Pasadena, Calif.

At NASA Headquarters, David Lavery is the program executive and Dr. Catherine Weitz is the program scientist. At JPL, Peter Theisinger is the project manager and Dr. Joy Crisp is the project scientist. The principal investigator for the science payload is Dr. Steve Squyres from Cornell University, Ithaca, N.Y.

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